

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 457

Unalloyed Copper - Cu IV

(In Cooperation with the American Society for Testing and Materials)

This Standard Reference Material (SRM) is in the form of rods 6.60 mm (0.260 in) in diameter and 103 mm (4 in) long.* The SRM is intended for use in trace analysis of copper materials. It is designed for all techniques applicable to compositional analysis of unalloyed copper and it is particularly well suited for calibration with optical emission methods of analysis.

Element	Certified Value ^a μg/g	Estimated Uncertainty ^b	Element	Certified Value ^a μg/g	Estimated Uncertainty ^b
Antimony ^c	0.2	0.1	Nickel ^d	0.6	0.1
Arsenic ^c	0.2	0.1	Selenium ^c	4.2	0.2
Bismuth ^c	0.2	0.1	Silver ^d	8.1	0.1
Iron ^d	2.0	0.1	Tellurium ^c	0.29	0.01
Lead ^d	0.5	0.1	Tin ^c	<0.2	---
Manganese ^c	<0.1	---	Zinc ^c	<1	---
Element	Certified Value ^a		Estimated Uncertainty ^b		
	<u>Percent by Weight</u>				
Copper ^c , assay	99.96		0.01		

^aThe value listed for an element is the *present best estimate* of the "true" value based on the results of the analytical program for certification.

^bThe estimated uncertainty listed for a constituent is based on judgment and represents an evaluation of the combined effects of method imprecision, possible systematic errors among methods, and material variability for samples of 1.0 g or more. (No attempt was made to derive exact statistical measures of imprecision because several methods were involved in the analysis of most constituents.)

^cValues for Sb, As, Mn, Se, Te, Sn, Zn, and Cu are based on agreement of determinations at NBS and cooperating laboratories; values for Bi are based on agreement of determinations at cooperating laboratories.

^dValues for Fe, Pb, Ni, and Ag are based on determinations at NBS by two or more of the following methods; atomic absorption and flame emission spectrometry, isotopic dilution mass spectrometry, neutron activation analysis, and spark source mass spectrometry.

*Material from the same original continuous-cast rod product was processed to the form of rods 6.35 mm (1/4 in) in diameter, designated SRM 497. The smaller diameter rod material has not, as yet, been fully characterized. The larger diameter material (6.60 mm), SRM 457, is expected to serve as the base stock to form chips in the user laboratories (or to form the usual rods 6.35 mm (0.250 in) in diameter).

Gaithersburg, MD 20899
April 10, 1986
(Revision of Certificate
dated 1-20-78)

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(Over)

PLANNING, PREPARATION, TESTING, ANALYSIS: This material is one in a series of twelve different composition copper "Benchmark" materials, Cu "O" through Cu XI, that are being prepared in a cooperative Industry-ASTM-NBS Program.

Base material for the preparation of Cu IV was supplied by the Magma Copper Company, San Manuel Division, San Manuel, Ariz., courtesy of T.L. Young. Copper cathodes were melted and continuously cast into rod (about 320 kg) 7.92 mm (0.312 in) in diameter, which was coiled.

The continuous-cast rod material was machine shaved through silicon carbide dies to form SRM 457 (and SRM 497) at the Kagen-Dixon Wire Corporation, Arkansas Division, Osceola, Ark., courtesy of J.A. Hollis.

Preliminary analyses, primarily by optical emission methods of analysis, were performed in the analytical laboratories of:

Anaconda Company, Primary Metals Division, Raritan Copper Works, Perth Amboy, N.J., P.F. Stryker and A.J. Simon.

Kennecott Copper Corporation, Kennecott Research Center, Salt Lake City, Utah, A.P. Langheinrich and T.N. Andersen.

Kennecott Copper Corporation, Utah, Copper Division, Refinery Plant, Magna, Utah, N.N. Linde.

Kennecott Refining Corporation, Baltimore, Md., A.A. DiLeonardi.

Magma Copper Company, San Manuel Division, San Manuel, Ariz., T.L. Young and S.K. Young.

Phelps Dodge Refining Corporation, El Paso Works, El Paso, Tex., A.L. Cardinal.

Specimens for homogeneity testing were obtained to be representative of the leading, middle, and trailing sections of the rod stock. These were end-milled to chips and carefully blended. Cooperative homogeneity studies were made at Kennecott Refining Corp., Baltimore, Md., by optical emission spectrochemical analysis, A.A. DiLeonardi. Extensive homogeneity studies were made at NBS Boulder, by residual resistivity ratio measurements, J.G. Hust, and at NBS Gaithersburg, by chemical analyses (see listing below). The results indicated the maximum gross material variability to be less than 5%.

Cooperative chemical analyses for certification were made on composite samples in the following analytical laboratories: Anglo American Corporation of South Africa Limited, Johannesburg, Republic of South Africa, R. Murray-Smith. Council for Scientific and Industrial Research, National Physical Research Laboratory, Pretoria, Republic of South Africa, L.R.P. Butler, D.B. deVilliers, and J.H. Wepener.

Kennecott Copper Corporation, Research Center, Salt Lake City, Utah, A.P. Langheinrich and T.N. Andersen.

Kennecott Refining Corporation, Baltimore, Md., A.A. DiLeonardi.

South African Bureau of Standards, Physical Chemistry Division, Pretoria, Republic of South Africa, H.P. Beyers and P.G. Odendaal.

Analyses were performed in the NBS Analytical Chemistry Division by the following: I.L. Barnes, R.W. Burke, B.I. Diamondstone, M.G. Diaz, E.L. Garner, L.A. Geldner, J.W. Gramlich, G.J. Lutz, L.A. Machlan, T.J. Murphy, P.J. Paulsen, L.J. Powell, P.A. Sleeth, and R.K. Bell, ASTM-NBS Assistant Research Associate.

The overall direction and coordination of the preparation and fabrication of this material were performed by J.G. Hust, NBS, Boulder, Colorado.

The overall coordination of the NBS analytical measurements leading to certification was under the direction of I.L. Barnes.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R.E. Michaelis.

ADDITIONAL INFORMATION: Details concerning the planning, preparation, testing, and analysis of this material and other copper "Benchmark" materials are to be published in an NBS Special Publication (260 Series). Information that should be of immediate interest to the user laboratories follows:

Prior to using this rod SRM (especially after any machining, cutting, or drilling operations) the specimen should be etched to remove any contaminated material. (Suggested etch: Use a 1:1 solution of nitric acid, follow with a 1:1 solution of hydrochloric acid, rinse with distilled water, and dry in air on filter paper.)

Elements other than those certified may be present in these materials as indicated below. These are *not certified* but are given as additional information on the composition.

Elements Detected	Information Value, $\mu\text{g/g}$
Aluminum	(<2)
Cadmium	(<1)
Chromium	(0.3)
Cobalt	(0.2)
Gold	(<0.05)
Magnesium	(<1)
Oxygen	(360)
Silicon	(<2)
Sulfur	(4)
<u>Elements Not Detected</u>	
Calcium	(<0.3)
Titanium	(<0.3)

